THE REPUBLIC OF NAMIBIA

Ministry of Agriculture Water and Rural Development

Directorate of Rural Water Supply (DRWS)

THE REPUBLIC OF FINLAND

Ministry for Foreign Affairs

Finnish International Development Agency (FINNIDA)

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION[1]

WATER SUPPLY DEVELOPMENT PLAN FOR THE WESTERN PART OF OHANGWENA REGION

R58 / a / C / 14.3.1994

VOLUME I, SUMMARY

First Draft

FINNCONSULT
Project No: 28103701-6

[1] b:wsdevpl.a94

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ABBREVIATIONS AND ACRONYMS

DPA	Discontinuous Perched Aquifer
DRD	Directorate of Rural Development
DRWS	Directorate of Rural Water Supply
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
FIM	Finnish Mark
FINNIDA	Finnish International Development Agency
LSU	Livestock Unit
MAWRD	Ministry of Agriculture, Water and Rural Development
MEC	Ministry of Education and Culture
MHSS	Ministry of Health and Social Services
MRLGH	Ministry of Regional and Local Government and Housing
MSA	Main Shallow Aquifer
MWP	The Regional Master Water Plan for Owambo Region
NDT	Namibian Development Trust
NGO	Non-Governmental Organization
N$	Namibian Dollar
O&M	Operation and Maintenance
RDC	Rural Development Centre
RWS	Rural Water Supply
TDS	Total Dissolved Solids
WASP	Water and Sanitation Policy
WSDP	Water Supply Development Plan
WSSPOR	Water Supply and Sanitation Project in Ohangwena Region

1 BACKGROUND INFORMATION

1.1 Physical Characteristics

Ohangwena Region lies in the north-central part of former Owambo, which is situated in the most northern part of Namibia. The topography of the region is characterized by an extremely flat plain, which forms part of the larger Etosha Depression, and gradually slopes as a shallow trough from north to south towards the Etosha Pan. The common parent material of the alluvial plain in the region is a remarkably uniform, relatively unweathered, medium-textured sand. It can generally be stated that grey sands cover the whole of the eastern area, while red and brown sands are characteristic in the gentle relief of the western area of Owambo.Two thirds of the Project Area is covered with aeolian sands. Solonetz soils occur in the remaining third as a broad north - south striking strip in the central part of the area. The Mixed Woodland areas, associated with aeolian sands, are located in the whole area. Vaalboom and wild seringa are the main species. The grass cover is moderate, but in the eastern area the grass tends to be less palatable than elsewhere. To a large extent this area has been denuded of vegetation, except for fruit trees, due to the use of timber for palisades and firewood,overgrazing and the clearing of land for cultivation.The grass cover is moderate, consisting of various perennial and annual grasses.

The main feature of the drainage system is the Cuvelai Delta in central Owambo,The seasonal flood in the Cuvelai, the efundja, does not always cross the Namibian border and only very rarely reaches the Etosha Pan. Owambo experiences seasonal rainfall in the summer months between October and April. More than 70% of the rainfall occurs between January and March. The planning area receives the range of 440 mm to 510 mm for rainfall, and 2725 mm for evaporation.

October and November are the hottest months, with the average daily maximum temperature in October being 35.5°. Winter days are mild, but cold at night, average daily minimum temperature being 6°. Strong winds are rare, but may occur before and during thunderstorms.

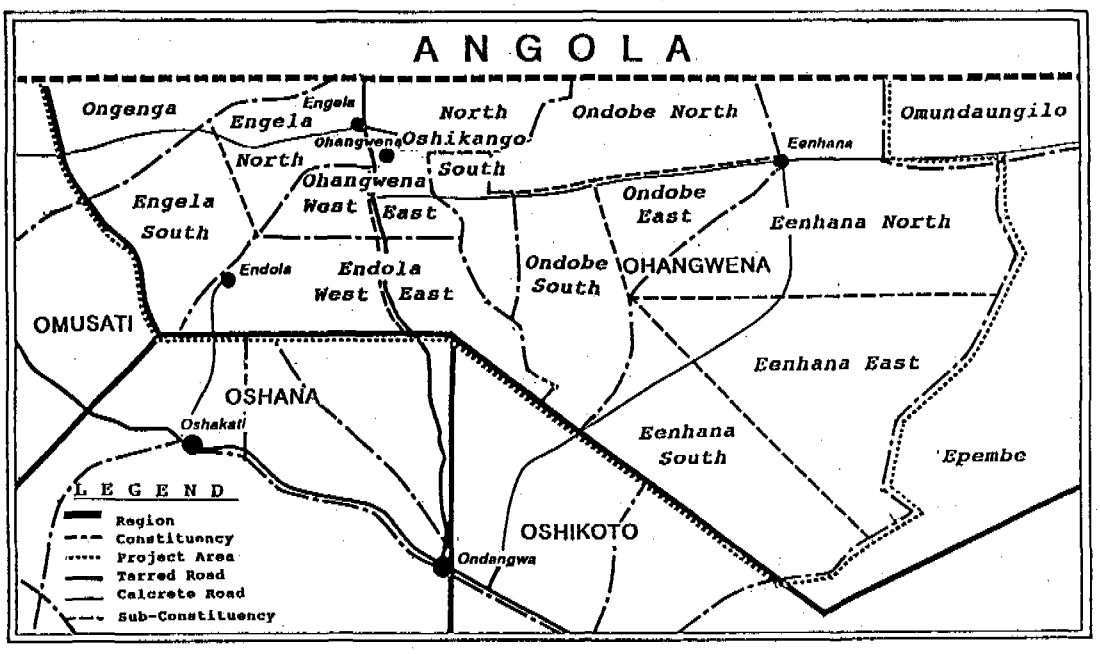
The successive layers of sand sandy clay sandstones and conglomerates of Kalahari Group are up to 500 m thick and the planning area is underlain by this sediment. Only 2 of the major groundwater areas occur within the area, namely the Brine lake and Eastern areas. Potable groundwater reserves are hosted by deep aquifers in the eastern area and as shallow aquifers in the brine lake area. The underground Brine Lake occurs in the centrally located Cuvelai Basin. The groundwater of the deeper, regional aquifer was found to be unsuitable for consumption due to very high concentrations of total dissolved solids. The concentrations may vary between 3,000 mg/l and 33,000 mg/l.

It is estimated that on average 83% of the total rainfall evaporates shortly after precipitation, while 17% is available as surface run off, of which 1% recharges groundwater resources and 14% is lost through evapotranspiration. Since the eastern areas of the Project Area are covered by loose Kalahari sands and with hardly any surface run off channels, infiltration should be good.

1.2 Socio-Economic Development

Administratively Ohangwena Region is divided into 10 constituencies. The Planning area and the administrative boundaries are shown in **Picture 1.** The unit around which the social and economic life is organised is the egumbo (household or homestead). An egumbo is headed by a mwene gwegumbo (household head) who can be a male or a female. The average household size varies between seven and eight people. Each egumbo is surrounded by cultivated land. A group of egumbos - in some cases more than fifty - form an umukunda.

Picture 1: Administrative boundaries



Historically the Ohangwena Region had a strong hierarchical system so a chief/king and senior and junior omalengas (headmen) who were concerned with community matters. The 1992 Regional elections which put into place a Regional Governor and Councillors representing the various Constituencies in the region was fought along party political lines. The Regional Council is in charge of the day-to-day administration and development of the region but it is not supposed to replace the system of chiefs and headmen. It is clear that the importance of the chief and the headmen as non-party political figures has been recognised but their future roles and positions are still not clearly defined.Women of the Region are responsible for household chores and child care. In this area the high incidence of absent males puts an additional burden on them in terms of decision making and labour. The 1994 study of NDT indicates that female headed households remain economically worse off than male headed households.Community groupings in Ohangwena are mainly related to church activities and participation in women's group activities is very low.

In Ohangwena, like in other rural communities, only a small percentage of the population attend school beyond standard 6 (grade 8). The figure quoted for Ohangwena is 20%. This means that even traditional leaders and heads of household are often under-educated and semi or illiterate.

The health situation in the Ohangwena region is characterized by problems occurring due to inter alia low standards of living, lack of education, unavailability of health information, and the shortage of primary health care services and facilities. Malnutrition in the area is above

the national average, with over 30 % of pre-school children suffering from moderate or severe undernutrition.
Some of the major local health problems, such as malaria, diarrhoea, dysentery, and other communicable diseases, are closely related to water and sanitation issues, and their occurrence follows a distinct seasonal cycle. The incidence of diarrhoea, for example, increases with salinity and contamination of water sources, especially towards the end of the dry season, whereas the number of malaria cases rises in the late part of the wet season.

The precise standing of communal land in terms of ownership and land rights, and the complex role of tribal leaders in the allocation of land have not yet been clearly defined. At present the right to use arable land is obtained through the head of the household making a payment to the headman or chief. When the head of household dies there is no automatic right of inheritance, and continued occupation normally depends on future payment.

The tarred trunk road B1 to Angola runs through the Planning area. Oshikango - Engela is one of the fastest growing points in the Region and it has already become an important service centre with a shopping area and a market. Small public service vehicles (taxis) play a major role in the public transportation system. There is still a big need for the rehabilitation of lower quality access roads in the rural areas.

Semi-urban areas are supplied with electricity and the rural electricity supply network is developing rapidly in the Project area. However, the present use of electricity is very low e.g. for cooking 0.3 % and for lighting 1.0 % only. There is a post office in Ohangwena. A postal agency provides services at Omungwelume. Manual telephone exchanges will be replaced by a new digital multiple radio system during 1994. The television provides services within a radius of 60 km around Oshakati.

There are 135 primary and secondary schools in the Planning area. The number of schools, teachers and students according to the constituencies are shown in the **Table 1.**

Table 1. School data, 1993

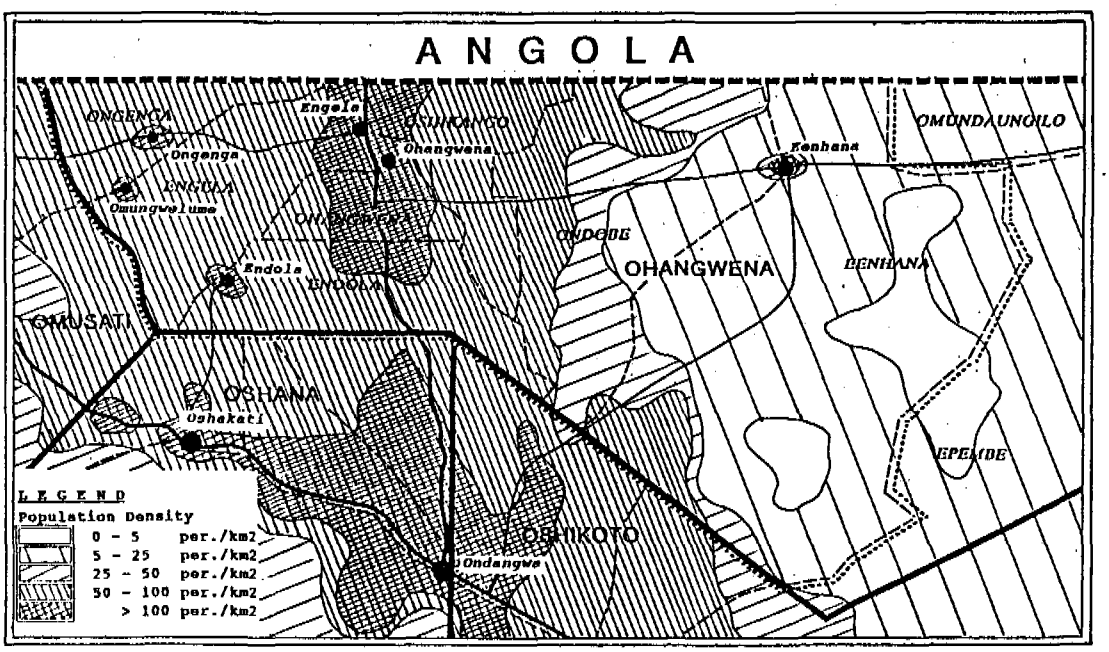
	Number of schools	Number of teachers	Number of studens
Eenhana	25	125	6119
Endola	20	170	8861
Engela	25	253	11022
Ondobe	22	162	8475
Ongenga	16	179	7249
Ohangwena	11	157	7489
Oshikango	16	172	8835
TOTAL	135	1218	58050

In the Planning area two new hospitals (at Engela and at Eenhana) are under construction, and one health centre.(at Odibo) are being upgraded. In addition 18 health clinics will provide daily services to the people who are living in the Planning area. The urban population growth rates range from about 23.00 % in Oshakati - Ondangwa nexus to about 7 % in semi-urban centres in the Planning area. The distribution of the population in the Planning area shows that 113 000 of the total population live in rural areas while 11 700 persons live in semi-urban localities.

For the population forecast the constituencies are divided into the sub-constituencies in order to have more accurate population forecasts. In **Picture 1.** administrative boundaries and sub-constituencies are shown. Population estimates for the Planning area at the end of 1993 appear in **Annex 1.**

On both sides of the Ondangwa - Oshikango road the population density is nearly 100 people per km2. The population distribution is influenced by road access, the siting and density of serviced dwelling plots and the position of water points. The average population density is 50 persons per km2 in the Western part of the Planning area. A simplified population density map is shown in **Picture 2.**

Picture 2: Simplified population density



Two scenarios have been built using the following assumption:

Assumption:

The average growth rate is 3.03 % during the planning horizon of 12 years in the Project Area.

Scenario 1:

The rural population increase between 1993 -2005 is 2.84 % per annum and it is expected that urbanized people in the Project area will increase by 5 % per annum.

Scenario 2:

The annual growth rate in the rural areas between 1993 - 2000 is 2.2 % per annum and it decreases in 2000 to about 1.5 % per annum in 2005. It is expected that the semi-urban population growth between 1993 - 2000 is 7.1 % per annum and between 2000 - 2005, 9 % per annum. The migration from the Project area will be 22 % per annum between
1995 - 2005.

Results of the forecasts according to the above assumptions appear in **Annex 1.**

The traditional economy of the Ohangwena Region is based upon three main activities: rain-fed agriculture, livestock farming supported by migratory seasonal grazing, and silvi-culture. Livestock production is integrated with crop production. The agricultural calendar has implications with regard to the availability of labour for digging water pipeline trenches, as well as for payment of user charges and maintenance of rural water supply systems.

The production of crops consists primary of millet, sorghum, beans, pumpkins and melons. The staple food crop and main agricultural activity in the Ohangwena Region is the cultivation of pearl millet, better known as mahangu. Agriculture, supplemented by income from migrant labour and pensions, forms the basis of the economy of the Ohangwena region.

Cattle farming is one of the most important activities in the Ohangwena region. The livestock component of agriculture consists of cattle, goats, sheep and donkeys. In the absence of a rural banking system, the cattle herd is the family's stock of wealth and source of milk, meat, traction and manure. The average herd size is 7.6 head of cattle and 5.5 goats. A family owns on average 9.5 head of livestock. The bulls and donkeys are used for ploughing but very few farms use them for drawing and transport of water. In **Table 2** the estimated number of stock as well as the stock according to carrying capacity in the Project area is shown.

Table 2: Livestock norms and data

Constituency	Livest. LSU unit/10ha	Livest. LSU unit/15ha	Livest. estimation 1993
	16600	11000	22000
Endola	3700	2400	5500
Engela	4200	2800	6000
Ondobe	7400	4900	11000
Ongenga	2300	1500	3500
Ohangwena	1800	1200	2500
Oshikango	2900	1900	4000
TOTAL	38900	25700	~55000

The productive cattle yield is less than 5% per annum whilst it could theoretically attain 10%. The reason for this can be found in the fact that the management of cattle herds has no commercial aim.

There are some excavated dams and storage dams developed for fish farming in the Project area. However, due to the high evaporation in the area fish farming is seasonal.

The Eastern part of the Project area is a forest. It is used for grazing and also for fuel and building purposes. The sale of wood is more and more prevalent along the roads due to the high demand for fire wood in the Region. These practices have led to nearly total deforestation of the Central and Western part of the Project area.

There are some reliable quantitative data available on family incomes. The comparable figure for 1992 varies from a low N$ 1 104 to a high of about N$ 3 000 per annum. Wage employment and remittances are now the most significant sources of family income. Income variation between households is more closely correlated to the access with which young people get urban employment and maintain their home linkages rather than to differences in agricultural productivity.

1.3 Assessment of the Planning Situation

The Regional Master Water Plan for Owambo Region (MWP), published in March, 1990, is the latest document which will provide latest information for water supply development in the future.
This plan will not give detailed and permanent solution for water supply in the entire Project area. Also the environmental impact of the solutions has not been clearly addressed in the MWP.
The Planning Report on the Proposed Oshakati - Omakango Regional State Scheme gives the detailed data from s.c. Herringbone System and recommendations for it's developing.

2 WATER RESOURCES

2.1 Surface Water Resources

The Master Water Plan (1990) made proposals for meeting the estimated water demand through the establishment of the following water supply infrastructure:

* Extension of the then existing system of canals and pipelines to feed water from the Caleque Dam in Angola into the interior of Owambo.
* Continued construction of storage dams which could be fed with water from local run-off or from the proposed water supply network.
* Drilling of additional boreholes in the eastern and western farming areas.
* The construction of wells and cisterns to serve rural schools and clinics.
* The development of irrigation schemes.

The priorities determined by the Master Water Plan were to develop local water sources first, and then to import water from the Kunene River. This principle still applies today.

The study area has no perennial rivers within it, and the only sources for surface water would be the seasonal flooding of the local drainage, or man-made storage facilities. The potential supply of water from the Kunene is large and water is imported into the area via surface canals and pipelines.

The oshana system covers one third of the Ohangwena Water and Sanitation Project Area. There is little information on ephemeral surface water and no reliable measurements are available. In 37% of the seasons, no flow occurred in the oshana at Oshakati. Due to the ephemeral nature and irregular occurrence of the Efundja, as well as the large variation in and distribution of local rainfall, the water in this oshana can not be considered as a reliable long-term water source for Owambo. Because the oshana system is an inland drainage system, with less rain than evaporation, there is a tendency for the salt content of the soil and water to increase. It can be seen that the perennial water of the Kunene will in future continue to be an important factor in urban and peri-urban development in central Owambo. Surface catchments in the area are minimal.

Some secondary catchment occurs in the borrow pits which have accompanied road development programs of recent years, but the total contribution to surface water resources is minimal. The low-relief topography mitigates against the establishment of any primary catchment areas.

2.2 Shallow Water Resources

Two shallow aquifers have been identified in the western part of the Project Area:

* *Main Shallow Aquifer (MSA)*
* *Discontinuous Perched Aquifer (DPA)*

The MSA is currently developed by "ndungus" (deep hand-dug wells) and is the major source of drinking water. Ndungu depths can vary between 10 and 30 m, and, if lined, are done so with bricks, concrete rings or timber. Whereas the omafima are normally shallow enough to allow for manual extraction of the water, the ndungus often have simple hand pumps installed.

The DPA is an ephemeral or seasonal water source, located mainly in the oshanas, at depths of less than 15 m. During the dry season water levels drop considerably and commonly omafima dry out completely for a number of months. The depth of the potable water body seldom exceeds 40 centimetres. The preponderance of ndungus is in the central to central-east portion of the Planning area. Over most of the area, the water table is found at about seven meters below ground level. The ndungus can be considered as permanent water sources, unreliable only during very dry periods.

A rough calculation can be made for omafima in the western third of the area. Assuming that oshana surfaces account for 10% of the total surface area, and assuming that water intersection over the total area is the maximum encountered of 40 centimetres, the total volume of water recharging the system, and therefore theoretically abstractable for any one season would be of the order of 9,600,000 m^3 In the case of ndungu reserves, assuming a total surface area, east of the 0,3 m intersection contour line, of 576,000,000 m^2, and a mean penetrated depth of 0.5 m, a rough calculation of stored reserves would be of the order of 288,000,000 m^3. However, how long this would be sustainable would depend on recharge, for which there is no information.

2.3 Deep Ground Water Resources

The Deep Aquifer occurs below a depth of 50 m, is commonly saline and becomes more saline with depth. Most of the Ohangwena area is underlain by this aquifer. This salinity has been interpreted as connate waters dating back to the time of formation of the palaeo-lake Etosha. Significantly, the Deep Aquifer appears geographically related to the 130 m topographic contour, which has been interpreted as representing the maximum palaeo-lake shoreline (Rust,1984). Above this contour the quality of groundwater from the deep aquifer increases progressively.

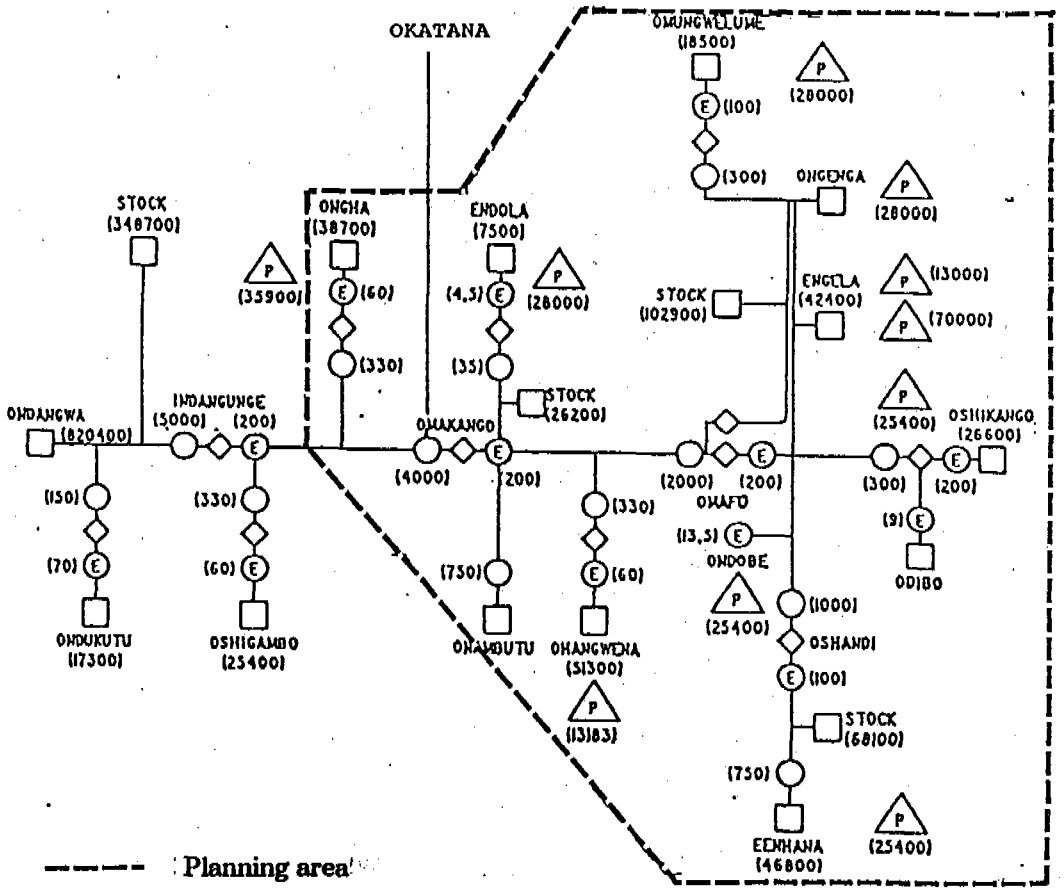
Most of the Study Area, except for the far eastern parts, lies below this topographic contour, indicating that there is very little chance of encountering fresh groundwater in this area. Boreholes in the eastern area, that is to the east of the Brine Lake Area, have generally been 85% successful, with yields in the order of 2 to 5 m^3/h at depths of 70 to 90 m. The water is potable and the concentration of total dissolved solids in the water is about 500 mg/l.

3 EXISTING WATER SUPPLY INFRASTRUCTURE

3.1 Bulk Water Supply System

The bulk water supply network in the Central North Namibia is the largest water supply system in the country. It presently consists of 29 pump stations, 950 km of pipelines, 92 km of canals and 9 purification plants. Ondangwa-Oshikango main pipeline comprises a major bulk water supply artery running from Ondangwa in the south to Oshikango in the north. A number of pipeline branch off from this pipeline and it is popularly known as the Herringbone Scheme. The total length of the existing pipeline is around 200 km. A new pipe line (48 km) from Omafo to Eenhana is under construction and also Omakango - Onambutu pipe line is under upgrading. The layout of this scheme is shown in **Picture 3.** The project area is shown by the dotted line.

Picture 3. The schematic lay-out of the Herringbone system



Symbol	Capacity of Component and Units	Description
	( ) m3/a	Consumer
	( ) m3	Pumped storage dam
	( ) m3/a	Pipeline
	( ) m3/h	Pumping station
	( ) m3	Clear water reservoir

3.2 Rural Point Water Supply System

3.1.1 Unprotected Water sources

Ndungus

Communities who are living between oshanas have dug so called ndungus in the sand bed for their own water supply. Generally ndungus are found in the areas where fig, palm and marula trees exist. The top part of the ndungus are consolidated by wooden logs and they are about 15 -20 m deep.

Omafimas

During the dry winter months communities are used to dig omafimas in Oshana beds, when all other surface water resources are getting dry. These wells have a very low yield and they can provide water from one to three families only. It is estimated that there are approximately 1800 ndungus and omafimas in the Planning area.

Dams

There are 8 dams in the Planning area and mainly they have been constructed in the early sixties. Most of them have silted up and are not in operation.

3.1.2 Protected Water Points

Wells

There were about 300 protected wells constructed by different institutions, NGO's and organizations in the Planning area by the end of December 1993. By the end of 1993, the WSSPOR had constructed 36 hand dug/borehole wells estimated to serve 1000 rural people. The depth of the wells ranges between 5 m and 18 m and they are equipped with hand pump or windlass. Water quality is generally good. Communities have contributed to the construction of water points and they are responsible for their maintenance.

Boreholes

At present about 30 boreholes have been drilled in search of drinking water in the Project area, and only three of these have reasonable yield and water quality. Most of them have been abandoned because of the saline ground water.

Roof Catchments and Water Tanks in the Schools

There are some 25 roof catchment systems built for the schools in the Project area. The size of water tanks ranges from 10 m3 to 45 m3. These water storage services are very limited and dependent on rain fall.

3.3 Water Supply Coverage in the Planning Area

3.3.1 Pipe Water Supply Coverage

To determine the rural water supply coverage it is assumed that the population and its livestock along a 2 km way on either side of the pipeline (a total of 4 km) will get their water from the pipeline. The present water demand and water supply coverage calculations are presented in **Annex 2.** Accordingly the existing water supply network and theoretical water supply coverage is presented in **Annex 3.**

It is estimated that about 37 % of the total population in the planning area are within the pipe water supply service. The pipe water supply coverage has been cross checked with the capacity and operational data provided by the DWA.

3.3.2 Point Water Supply Coverage

Some 2150 water points (Ndungus and Omafimas) were identified in the planning area. It is estimated that 41 % of the total population in the planning area are somehow within the point water supply service. If water quality is taken into consideration the number of people served by water which fulfils quality standards is much lower.

4 WATER DEMAND

The unit water demand has been adopted from the re-evaluation of water demand norms for planning purposes, published by DWA in April 1992.

Consumer served by Piped Water Supply	Unit
Community stand pipes	25 l / day / person
Semi - Urban area stand pipe	60 l / day / person
Clinic out - patient	30 l / op. / day
Clinic as a whole	1000 l / cl. / day
Clinic per bed	300 l / bed / day
Hospital	500 l / bed / day
School	15 l / pup./ day
Livestock	45 l / LSU / day
Consumer served by Point Water Supply	
Community	20 l / day / person
Livestock	max 45 l / day / LSU, if water available

In order to assess the future water demand in the planning area it is assumed that the increase of water consumption will correspond to the expected increase of the population. Irrigation, forestry and fish farming are not taken into consideration when calculating the water demand. The domestic water use is the first priority and thereafter comes livestock. The present and future water demand are shown calculated based on the following assumptions as shown in **Tables 3 and 4.** A break-down of domestic water demand is shown **in Annex 3**

Assumptions

* 1 LSU/10 ha residing less than 2.5 km from the pipeline
* growth rate of students 4 %
* health facility demand based on growth rate of population
* the commerce and industry not included. To be assessed case by case

Scenario 1:

* average growth rate 3.03 %
* growth rate in rural area 2.84 %
* growth rate in semi-urban 5.10 %

Table 3. Present and future water demand, Scenario 1

CONSUMER	WATER DEMAND M3 / DAY			
	1993	1995	2000	2005
Semi-Urban	750	820	1040	1330
Rural population	2480	2750	3210	4060
Livestock	450*	600	800	1010
Health services	220	250	300	350
Schools	870	930	1100	1250
GRAND TOTAL	4770	5350	6450	8000

* Livestock served by pipewater supply

Scenario 2

* average growth rate (1994 - 2000) rural 2.2 %
* average growth rate (2000 - 2005) rural 1.5 %
* average growth rate (1994 - 2005) s-urban 7.1 %
* migration growth rate (1995 - 2005) rural 22.0 %

Table 4. Present and future water demand, Scenario 2

CONSUMER	WATER DEMAND M3 / DAY			
	1993	1995	2000	2005
Semi-Urban	700	870	1220	1710
Rural population	2480	2650	2930	3230
Livestock	450*	600	700	800
Health services	220	250	300	350
Schools	870	920	1000	1060
GRAND TOTAL	4770	5300	6150	7150

* Livestock served by pipewater supply

The growth rate of number of students has been estimated at 4% during the planning period. The future water demand for the health facilities has been estimated on the basis of the existing water demand, using an annual growth rate equal to that of the population. The water requirement of commerce and industry are unknown, and therefore the rate has to be assessed case by case and not taken into the development plan at this stages.

5. WATER SUPPLY OPTIONS

5.1 Water Resource Options

The feasible water supply options for the planning area are based on the existing water resource and source options, and on the various water supply technologies. The water resource options are illustrated in **Picture 4.**

Picture 4. Water resource options

Water resource Options	Potential in the project area	Constrains
Rain Water	450 mm / year	Good quality Not reliable
Surface water	Oshana drainage system 500 000 m3 / a	Poor quality Not reliable
Perched ground water	0.5 m3 / well / day 3 households Walking distance 1 km	Good quality Low yield
Medium shallow ground water < 70m	4 m3 / well / day 8 households Walking distance 2 km	Fair quality Fair yield
Deep ground water > 70m	4 m3 / hr 15 households Walking distance 3 km	Good or poor quality N/A for hand pump Expensive

5.2 Technology Options

The technology options based on different water resource options and source options have been presented in **Picture 5.** Because the Kunene River is not in the planning area it has not been considered as a water resource. Anyhow, the bulk water supply is one of the resource options.

Picture 5. Technology options

Water resource Options	Source Options	Technology Options
Rain Water	Roof catchment	Water tank / Tap
Surface Water	River	Water treatment / Piped water
Surface Water	Oshana	Dam / Filter / Hand pump
Surface Water	Oshana	Artificial Ground Water / Windlass
Perched Ground Water	Shallow well	Brick well / Hand pump / Windlass
Medium Shallow Ground Water	Shallow Well Tube Well	Hand pump
Deep Ground Water	Tube Well	Submersible or Hand pump

5.2.1 Bulk Water Supply

The following technical advantages of the Bulk water supply have been recognized:

* water quality can be controlled.
* water can be supplied to the areas, where local water resources are not available
* bulk water supply can provide high service level.
* drought effect not remarkable
* a large number of consumers can be served easily.
* it can promote the establishment of possible irrigation and commercial project

The disadvantages of the Bulk water supply are:

* intake capacity is limited to 6 m_3/s, according to an agreement between Namibia and Angola.
* canal from Caleque to Oluhandja capacity is limited to 3.5 m_3/s.
* construction of a new canal, pipelines and Oshakati purification plant will require substantial initial investment costs.
* canal maintenance is costly and difficult

5.2.2 Rural Pipe Water Supply

The following technical advantages of the Rural Pipe Water Supply have been recognized:

* water quality can be controlled.
* water can be supplied to the areas, where local water resources are not available
* can serve the population also during the dry period
* livestock water demand can be met

The disadvantages of the Bulk Water supply are:

* illegal connections.
* expensive development and O & M costs 3.5 m_3/s.
* water shortages are common
* revenue collection difficult

5.2.3 Point Water Supply with Hand Pump

In the planning area the average shallow well depth is about 15 m and the depth of well using MSA about 20 - 50 m. The depth of the deep ground water tube wells is more than 100 m.

The hand pump well has the following advantages:

* water is relatively safe and protected
* hand dug well can be constructed using local skills and materials
* the operation of the hand pump requires no external power
* local technicians can maintain hand pumps

The disadvantages of the hand pump well are:

* contamination risk exists during the rainy season
* hand pump wells are reliable only in the areas where good ground water is available at shallow depths throughout the year
* can not be used in deep tube wells, where ground water level is deeper than 100 m.
* corrosion high due to the salinity
* deep tube well pump repair require skilled manpower, special tools and it is expensive

5.2.4 Point Water Supply with Windlass

The WSSPOR has developed a well constructed at site and equipped with a bucket lifting system.

The advantages of the well with windlass are as follows:

* well can be constructed with minium external support using local materials and transport
* community is fully involved in all stages of well construction
* the windlass water point is easy to operate and maintain by the community
* it provides good protection for water contamination

The well with windlass has the following disadvantages:

* the capacity of the shallow well using perched ground water is limited and can only serve an average of 3 household
* there is a contamination risk during the rainy season
* wells might dry up during the dry season

5.2.5 Roof catchment

The advantages of roof catchment are as follows:

* low-cost technology can be used
* it will improve water supply situation in the schools which are without any reliable water supply system
* high community contribution
* local contractors are able to construct the systems
* storage capacity for tanker service

The roof catchment has the following disadvantages:

* not reliable because of low and occasional rainfall
* water quality control difficult

5.2.6. Dam

The dams are used mainly for livestock watering. During the last two years the RDC and the Development Brigade have constructed or rehabilitated some of the dams, also for domestic consumption.

The advantages of the dam are:

* excavations for road construction can easily be developed for livestock watering with minimum investment
* cheapest and easiest way to water the livestock in the oshana area, if normal rains occur

The disadvantages of dam are:

* only 40 % of the dam capacity can be utilized for water supply due to the high evaporation
* not a reliable water source due to low and occasional rainfall
* water is not suitable for domestic consumption without treatment
* increases risk of malaria

5.2.7 Other Methods

The methods and technologies which can be successfully used in special conditions in the planning area are:

* Artificial ground water / improved ground water recharge
* Desalination
* Solar systems

5.3 Cost

The households and livestock are considered as main beneficiaries of the planned water supply systems. The cost comparisons have been made by estimating the total development costs, operation and maintenance costs and community participation costs. The costs have been calculated based on 1994 prices. Technical assistance has not been taken into account.
The development costs include: materials, skilled labour, transport, community contribution and overhead.

The cost analysis has been calculated as follows:

Pipe water supply

* investment costs calculated with 10 % interest for 20 years using current price level
* renewal costs not included

Point water supply

* boreholes, 10 % interest for 15 years
* shallow well 10 % interest for 12 years

The recurrent costs of pipe water supply include energy, manpower, maintenance as well as transport costs. Maintenance costs of pipe water supply system has been estimated at 0.2 % of the development cost. Manpower and transport costs in the planning area at present include the following:

* one operator, 2 technicians, 2 plumbers and one lorry, with budget of 100 000 N$ per year
* interest 5 % annually

The recurrent costs for water point supply as a percentage of the investment costs have been estimated as follows:

* hand dug well with windlass 0.25%
* borehole (60 m) with hand pump 0.5%
* borehole (100 m) with hand pump 0.3

Community participation costs

* piped water supply: 9 % of the development costs
* point water supply:
  * shallow well; 32 % of the development costs
  * borehole well; 8 % "
  * borehole well; 4,5 % "

Based on the above assumptions the unit cost comparison has been summarised in **Table 5.**

Table 5. Unit costs of the water supply development

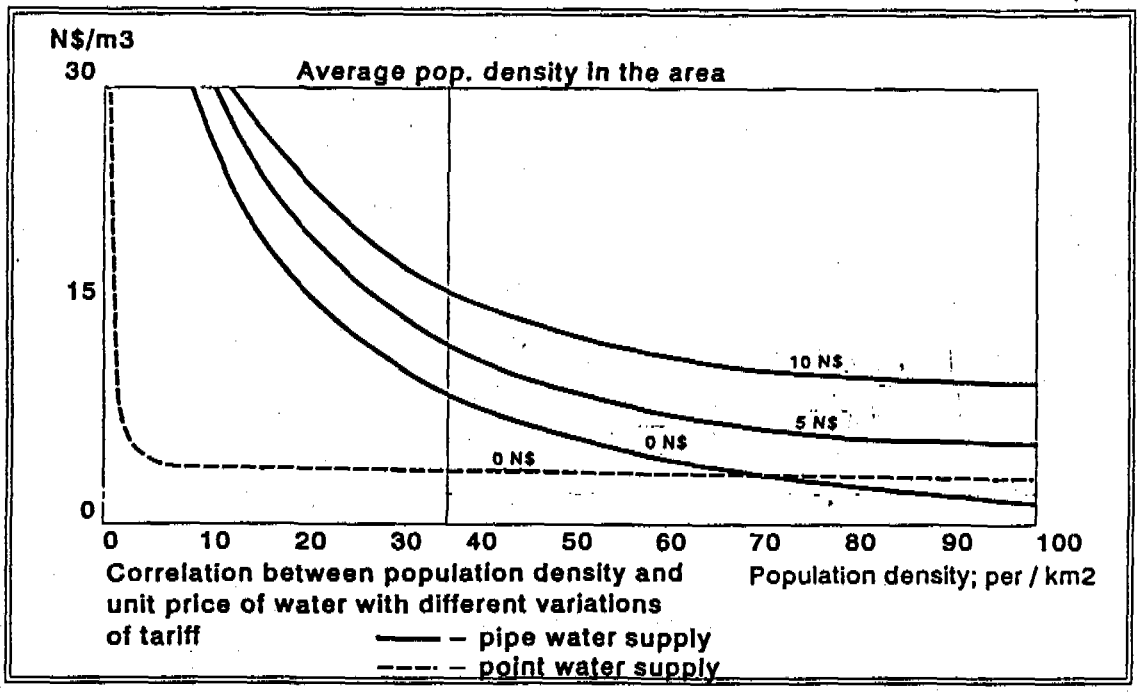
Supply area	Water supply System	Density Peop./Km2	Develop.Costs N$/ Cap./ Ann. Const.Costs	Comm.C	Total *	O&M Costs N$ / Cap./Ann. **	Total Exp.N$/ Capita/Ann.	Cost/m3 N$ ***	Ranking of Options
Rural	Pipe Water Supply								
	Network	100	13.45	1.35	14.8	17	31.8	1.8	I
		35	38.53	3.87	42.4	48	90.4	5.2	V
		25	53.97	5.43	59.4	67	126.4	7.3	VI
		5	269.86	27.14	297	334	631	36.4	VII
Rural	Point Water Supply								
	Windlass	N / A	16.02	7.5	23.7	4	27.7	3.0	II
	Borehole (60 m)	N / A	22.91	1.99	24.9	8	28.9	3.2	III
	Borehole (100 m)	N / A	28.17	1.33	29.5	4	33.5	3.7	IV

The unit price of the piped water supply system depends on the population density. The actual price of the bulk water supply at the boundary of the planning area has not been included into the above unit prices. Therefore the O & M costs include the costs of water distribution in the planning area only. If the population density is greater than 3 persons per km_2 the point water supply unit costs are not affected.

5.5 Technology Choice

The water production per day has been estimated for the proposed technologies (**Picture 4**). The unit costs per m_3 do not give accurate comparison of the different technologies due to varying service levels. The ranking of the options, as shown in the **Table 5**, has been proposed based on the unit price /m^3 and capita cost together. In the semi-urban areas where the population density is above 100 persons/ km^2 the piped water supply has been given the highest rank considering that the O & M is fully paid by the consumers. If the price of the water at the planning area boundary is added to the O & M costs the expansion of the piped water supply network is becoming questionable. The **Picture 6** illustrates the effect of the two different tariff rates to the actual price of the water.

Picture 6. Effect of the tariff to the unit price of water



6. PLANNING CRITERIAS

6.1 General

The Water Supply Development Plan for Western Part of Ohangwena Region has been developed based on the existing plans and existing water supply situation as well as existing water resources for the future improvement of water supply situation in the area. For this purpose the following criterias as presented below have been considered. The plan will follow the principles of the Master Water Plan for the Owambo Region when applicable.

6.2 Planning Horizon

The plan covers the period 1994 - 2005 with a greater detailed descriptio of the first six years period of 1994 - 2000.

6.3 Consumers to be Served

The plan focuses on domestic and livestock consumption. Also the institutional consumption is taken into consideration. The possible irrigation, commerce and industry are not covered. The target of the plan is to serve all of the population of the Project area by the year 2005,i.e. 100 % water supply coverage.

6.4 Service Level

The service level is the following:

The rural areas

* one shallow well per 3 households with a walking distance of 1 km
* one shallow tube well per 8 households with a walking distance of 2 km
* one deep borehole per 15 households with a walking distance of 3 km
* 25 l per capita per day
* water source: communal water tap or water well
* consumed water has to be paid when provided by the DWA

The semi-urban areas

* 60 l per capita per day
* water supplied through the public stand pipes or private house connections
* consumed water has to be paid according to the tariffs

6.5 Water Quality

The plan is based on the assumption that all water for domestic use will qualify for human consumption and will therefore conform with DWA water quality standards.

6.6 Selection of Technology

The selection of the technology for the rural water supply system is proposed to be based on the following aspects:

* systems should be reliable and easy to operate and maintain
* use of locally manufactured materials and equipment
* in power supply, electricity has priority over diesel or solar
* beneficiaries participation in both development and O & M favoured

6.7 Social and Culture Aspects

Special attention should be given to the following factors:

Taboos, beliefs and customs
Water is a resource over which women have traditionally had control. As main users and managers, they should be involved right from the start of the project. Cultural constrains which affect women's participation in water project should be studied carefully and campaigns to be launched to support women's effort in development

Local organizations and leadership
The project will facilitate setting up community level structures in collaboration with the Regional Council and individual counsellors and shall ensure that these structures and committees have multi-sectoral functions in order to develop an integrated grass-roots development capacity.

Utilization of local contractors and materials
The commitment of a community to any development effort will depend on the utilization of both the human and material resources available. Apart from the aspect of commitment, construction of water supplies will be much cheaper if local construction capacity is used for building, this would reduce the overall costs.
In order to improve the efficiency, and to decrease the dependency on the public sector the involvement and participation of the private sector will be supported. Private companies and/or artisans could assume a strong role in water supply development, maintenance, supplying of building materials, handpumps, spare parts and transportation. In the development of local water supply construction capacity the condition is that the costs of materials and services shall be on the affordable level to the communities.

6.8 Institutional Aspects

As a part of the institutional integration process the implementation of the activities shall be done in close cooperation with partner institutions. This will apply specifically in community sensitization and mobilization, hygiene education and sanitation promotion areas in which MHSS and MRLGH are involved. Other important actors are MAWRD and NGOs active in the area.

6.9 Financial Aspects

In order to achieve sustainable and affordable water supply development, the following principles are recommended:

* Cost shearing is the key target. Water tariffs shall be introduced to all beneficiaries and they should be informed of the development costs of their water supplies.
* In the rural areas the water tariffs shall cover the full operation and maintenance costs. In future the share of the present and future investment costs shall also be included.
* In the semi-urban areas the aim is full cost recovery of individual house connections: the water tariffs cover both development and O & M costs.
* Water tariff should encourage water conservation and reduce wastage.
* Community or users group management of the water supply systems implies that the consumers own their water supply systems, and take responsibility for managing it.
* Construction capacity development is to be encouraged in order to reduce the costs of the construction and keep the development cost at affordable levels for community to continue the use of these services without external support.

6.10 Priority Criterias

The unserved rural population should be given the first priority. Also all schools and clinics in the rural area should the high priority in design and construction of water supply systems.

6.11 Environmental Aspects

This water supply development plan draft has been prepared without considering the environmental aspects and possible impacts. Therefore the EIA study has to be carried out before completion of this plan and the possible effects of the study results have to be incorporated into the plan.

7. PLANNING GUIDELINES

The following *guidelines for the selection of development programmes are proposed:*

* The existing bulk water supply network should be maintained and extended where appropriate, feasible and affordable. Expensive rural pipe water network should be avoided in the areas of population density less than 100 people/km^2. The water for the stock farming areas should be supplied from possible groundwater or surface water sources.

* Groundwater sources should be utilized in those areas where the water is potable or suitable for stock watering. It is therefore necessary to embark upon thorough geohydrological investigations in order to establish the true nature of the hydrogeological environment in the planning area, especially with reference to the occurrence of a possible perched fresh water table which could be utilized by rural communities through digging of wells and installation of windlass or hand pumps.

* The provision of assistance to the rural communities in establishing safe drinking water supplies from wells and boreholes should be a major priority for improving health and welfare.

* Support should only be granted to communities which accept to make a defined counter performance. The size, type and timing of this counter performance will depend on the communities and on the water project characteristics.

* The importance of environmental assessments in proposing adequate management strategies is recognized whenever new water projects are designed and implemented. This should receive proper attention during all phases of water project development in Namibia.

8. DEVELOPMENT PLAN

8.1 General

The network modelling has been created based on the concepts being developed by DWA. The extension of the Omafo-Eenhana rural piped water supply network is the only project being designed at this moment.

The following have been presented in **Annex 3:**

* Existing water supply situation for 1993
* Implementation programme for 1993 - 1995
* Proposed implementation programme for 1995 - 2000
* Proposed implementation programme for 1995 - 2005

The development costs have been calculated according to the two scenarios for each option and the total costs are as follows:

* Scenario 1/ Option I: N$ 39 million
* Scenario 2/ Option I: N$ 35 million
* Scenario 1/ Option II: N$ 32 million
* Scenario 2/ Option II: N$ 28 million

The results clearly indicate that the population figures and its density are directly correlating with the development costs of water supplies. The detailed information is presented in **Annex 2.**

The time schedule for the implementation of option I (1994 - 2000) is probably unrealistic and will not be executed in the proposed scale due to other major financial needs for bulk water supply improvement in the Cuvelai Region. The migration from rural areas to the urban centres has been increasing and therefore it is assumed that scenario II is more realistic.

Scenario II and the development option II is proposed for the development plan based on the above facts and the technical and economical calculations. According to the guidelines for the programme selection it is proposed that local water resources and local construction capacity shall be exploited to the maximum extent in order to minimize costs and to achieve high local commitment in the management of the water supplies.

In the four semi-urban areas (Ohangwena, Engela-Oshikango, Eenhana and Omungwelume) the water supply coverage can presumably be improved upon by upgrading the existing piped water supply network. In the rural areas new systems are required if coverage is to be substantially increased. These new systems are required to supply the dispersed rural population, which presently depends on unprotected facilities shared with livestock. New systems are also required for the isolated institutions in rural areas such as schools and clinics.

The existing and proposed new pipeline network system, representing 74 % of the expected water supply coverage in 2005, will require 80 % of total expenditures during the planning period. The percentages required for point water supply system are 28 % and 20 % respectively.

It is expected that the communities will increasingly require water supplies with higher service level. However, when revenue collection will be based on full cost recovery the demand for the piped water supply will considerably decrease, while the demand for point water supply will increase.

8.2 Institution Building and Human Resources Development

At the beginning of 1993 the responsibility for rural water supply was transferred from the Directorate of Rural Development (Department of Agriculture) to the Directorate of Rural Water Supply (Department of Water Affairs). At present the Directorate of Rural Water Supply is responsible for planning, implementation and operation and maintenance of the rural water supply network.

The organogram of the DRWS has been approved by the Cabinet and Public Service Commission, but due to the lack of financial resources the actual start-up of full field operations will require a period of 3 - 4 years. The new establishment will actually have little influence in Ohangwena Region. Maybe only 2-3 water extension officers will be appointed for the Ohangwena Region in order to facilitate and control the development of community based rural water supplies. There are no further plans for office or other facilities in the region. Therefore the implementation and operation and maintenance of community based rural water supplies will greatly depend on the activity and participation of the communities themselves as well of the local NGOs and donors.

The WSSPOR, MRLGH, MHSS and some local NGOs are actively involved in community development work in the Ohangwena Region. There are plans to establish an intersectoral development committee network in the Region. The participation of traditional leaders, church representatives, political party representatives and different women groups should not be neglected when development or implementation plans are discussed or executed in the area.

8.3 Development Programme

According to the selected alternative, the total population of the planning area in the end of 2005 will be about 164 000, of which 28 000 people will live in the semi-urban centres. The average population density of the rural area is estimated at 35 persons per km^2.
The overall objective of the programme is to provide 100 % water supply coverage by the end of the year 2005. This will mainly be realized through a pipe water supply network supplying water for 128 000 people, which means constructing further 200 kilometres of pipelines. Part of the supply will be realized through point water supply that is to cover approximately 35 000 people in the most remote areas. This will require construction of 1150 water points.

Livestock (10 ha/LSU) and its need of water supply has been taken into account in the piped water supply system. In estimating the number of required point water supplies the livestock was not included. During the dry season the livestock use the same water source with the humans. In some cases animals are moved to the other grazing areas in the east of the planning area. If livestock were to be taken into account the number of required point water supplies would have to be tripled.

The total development costs of the new pipelines will be around 18.8 million N$, of which the community will contribute 1.5 million N$ (8 %). Cumulative operation and maintenance costs by the end of the planning period will be about 17 million N$. It can also be expected that renewal of the already existing pipelines will need an investment of 11 million N$ during the planning period. The development costs of the point water supplies will be approximately 9 million N$, with a community contribution of 1.7 million N$ (19 %) during 1994-2005.
The summary of the cost breakdown is presented in **Table 6.**

Table 6. The cost breakdown of the total costs of the proposed development programme

Development Costs of Water Supply

Supply Area	1994–2005			
	Constr. N$	Overhead N$	Comm.Contr.	Total N$
Rural pipe W/S	16,110,000	1,250,000	1,480,000	18,840,000
Rural point W/S	5,370,000	1,940,000	1,690,000	9,000,000
Total	21,480,000	3,190,000	3,170,000	27,840,000

Renewal Costs of Water Supply and equipment

Item	1994–2005			
	Constr. N$	Overhead N$	Comm.Contr.	Total N$
Main pipe line	9,000,000	1,500,000		10,500,000
Rural poin W/S	500,000	200,000	200,000	900,000
Equipments	1,000,000			1,000,000
Total	10,500,000	1,700,000	200,000	12,400,000

Operation and maintenace costs

Supply Area	1994	2005	Total O & M 1994–2005
	O & M N$	O & M N$	Total O & M N $
Rural pipe W/S	1,000,000	1,800,000	17,000,000
Rural point W/S	20,000	200,000	1,200,000
Total	1,020,000	2,000,000	18,200,000

It has been estimated that the average lifetime of a pipeline is 30 years, and that of the hand dug well with a windlass is 12 years. The lifetime of a borehole lifetime is estimated to be 15 years. Based on these assumptions, the new pipe lines will not require renewal during the planning period. Renewal of the existing pipelines will require approximately 11 million N$. However, the old wells constructed during 1980's by different organizations need to be reconstructed. The annual input for the renewal should be approximately 1 million N$, as presented in Table 6.

In the beginning of the planning period the piped water supply network operation and maintenance shall cost around 1 million N$ per year. This amount doubles when approaching the year 2005. The total expenditures of the implementation and O & M during 1994-2005 for the proposed development programme are N$ 58 million, and N$ 4,8 million annually.

8.4. Financing of the Development Programme

The current planned input from the Government of France by the end of 1995 is 9 million N$. That amount is supposed to cover the costs of the main pipe line between Omafo and Eenhana (3 million N$), as well as the extension of rural water supply along it, Phase I (6 million N$). Omakango - Onambutu pipe line will be financed by the Government of Namibia, with their planned input of 1,5 million N$.
According to the Agreement between the Governments of Namibia and Finland, the Government of Finland will contribute 11,7 million N$ (1 N$ = 1,7 FIM) for the improved rural point water supply and sanitation, by the end of 1996.
The average annual financing required for the implementation of the programme is about N$ 3,3 million.

It is also proposed that the possible subsidy is limited to the following:

* materials and equipment not available in the local market
* payment of building instructors
* payment of supervision, overall administration and other overheads
* technical assistance

9. CONCLUSIONS AND RECOMMENDATIONS

* The extension of the piped water supply network should be done only if:
  - community's contribution, participation and full cost recovery is secured
  - raw water and treated water resource capacity can meet the demand
  - all alternative water resources are already fully utilized

* Comprehensive study on the discontinuous perched aquifer to be carried out in order to define the reliable shallow water potential in the area

* The support for human resources development in the new directorate of rural water supply and in the communities should be encouraged and increased through advisory support

* More resources for the development and promotion of an appropriate and feasible billing and revenue collection system for rural piped water supplies to be given

* The self-reliance system for the water point repair and maintenance is to be developed and established

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POPULATION FORECAST 1993 – 2005

SCENARIO 1	POPULATION			
Sub-Constituency	**1993**	**1995**	**2000**	**2005**
Eenhana North Rural	2900	3100	3500	4100
Eenhana North Semi-Urban	2300	2500	3200	4100
Eenhana South	2000	2100	2400	2800
Eenhana West	7100	7500	8700	10000
Sub-Total Rural	12000	12700	14600	16900
Sub-Total Semi-Urban	2300	2500	3200	4100
Eenhana; Total	**14300**	**15200**	**17800**	**21000**
Endola East	8100	8600	9900	11400
Endola West	11200	11900	13700	15800
Sub-Total Rural	19300	20500	23600	27200
Sub-Total Semi-Urban	0	0	0	0
Endola; Total	**19300**	**20500**	**23600**	**27200**
Engela North Rural	12700	13400	15500	17900
Engela North Semi-Urban	3700	4100	5200	6600
Engela West	10200	10800	12500	14400
Sub-Total Rural	22900	24200	28000	32300
Sub-Total Semi-Urban	3700	4100	5200	6600
Engela; Total	**26600**	**28300**	**33200**	**38900**
Ohangwena East Rural	7100	7500	8700	10000
Ohangwena North Semi-Urban	3200	3500	4500	5700
Ohangwena West	7100	7500	8700	10000
Sub-Total Rural	14200	15000	17400	20000
Sub-Total Semi-Urban	3200	3500	4500	5700
Ohangwena; Total	**17400**	**18500**	**21900**	**25700**
Ondobe East	1000	1100	1200	1400
Ondobe North	8100	8600	9900	11400
Ondobe South	9200	9700	11200	13000
Sub-Total Rural	18300	19400	22300	25800
Sub-Total Semi-Urban	0	0	0	0
Ondobe; Total	**18300**	**19400**	**22300**	**25800**
Ongenga Rural	10200	10800	12500	14400
Ongenga Semi-Urban	3200	3500	4500	5700
Sub-Total Rural	10200	10800	12500	14400
Sub-Total Semi-Urban	3200	3500	4500	5700
Ongenga; Total	**13400**	**14300**	**17000**	**20100**
Oshikango North	10200	10800	12500	14400
Oshikango South	8100	8600	9900	11400
Sub-Total Rural	18300	19400	22400	25800
Sub-Total Semi-Urban	0	0	0	0
Oshikango; Total	**18300**	**19400**	**22400**	**25800**
TOTAL SEMI-URBAN	**12400**	**13600**	**17400**	**22100**
TOTAL RURAL	**115200**	**122000**	**140800**	**162400**
TOTAL	**127600**	**135600**	**158200**	**184500**

POPULATION FORECAST 1993 – 2005				
SCENARIO 2	POPULATION			
Constituency	1993	1995	2000	2005
Eenhana North Rural	2900	3000	3200	3,500
Eenhana North Semi–Urban	2300	2700	3800	5,400
Eenhana South Rural	2000	2100	2300	2,500
Eenhana West Rural	7100	7400	8100	8,300
Sub–Total Rural	12000	12500	13600	14,300
Sub–Total Semi–Urban	2300	2700	3800	5,400
		100	400	1,000
Eenhana; Total	**14300**	**15300**	**17400**	**19,700**
Endola East Rural	8100	8400	9200	9,600
Endola West Rural	11200	11500	12700	13,100
Sub–Total Rural	19300	19900	21900	22,700
Sub–Total Semi–Urban	0	0	0	0
Migration		300	700	1,700
Endola; Total	**19300**	**19900**	**21900**	**22,700**
Engela North Rural	12700	13200	14500	14,900
Engela North Semi–Urban	3700	4300	6100	8,500
Engela West Rural	10200	10600	11500	11,800
Sub–Total Rural	22900	23700	26000	26,700
Sub–Total Semi–Urban	3700	4300	6100	8,500
Migration		300	800	2,100
Engela; Total	**26600**	**28000**	**32100**	**35,200**
Ohangwena East Rural	7100	7400	8000	8,400
Ohangwena North Semi–Urban	3200	3700	5200	7,300
Ohangwena West Rural	7100	7500	8100	8,400
Sub–Total Rural	14200	14900	16100	16,800
Sub–Total Semi–Urban	3200	3700	5200	7,300
Migration		100	500	1,200
Ohangwena; Total	**17400**	**18600**	**21300**	**24,100**
Ondobe East Rural	1000	1100	1200	1,300
Ondobe North Rural	8100	8400	9300	9,700
Ondobe South Rural	9200	9500	10300	10,500
Sub–Total Rural	18300	19000	20800	21,500
Sub–Total Semi–Urban	0	0	0	0
Migration		200	600	1,600
Ondobe; Total	**18300**	**19000**	**20800**	**21,500**
Ongenga Rural	10200	10500	11500	12,300
Ongenga Semi–Urban	3200	3700	5200	7,300
Sub–Total Rural	10200	10500	11500	12,300
Sub–Total Semi–Urban	3200	3700	5200	7,300
Migration		200	400	900
Ongenga; Total	**13400**	**14200**	**16700**	**19,600**
Oshikango North Rural	10200	10500	11500	11,800
Oshikango South Rural	8100	8400	9200	9,700
Sub–Total Rural	18300	18900	20700	21,500
Sub–Total Semi–Urban		0	0	0
Migration		300	700	1,600
Oshikango; Total	**18300**	**18900**	**20700**	**21,500**
TOTAL MIGRATION		**1500**	**4100**	**10,100**
TOTAL SEMI–URBAN	**12400**	**14400**	**20300**	**28,500**
TOTAL RURAL	**115200**	**120900**	**130600**	**135,800**
TOTAL	**127600**	**133900**	**150900**	**164,300**

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION				PRESENT WATER DEMAND 1993					WATER SUPPLY COVERAGE 1993			
Project Area / Constituency / Sub – Constituency	Area	Population	Popul. Density	Target Poulation served by		Demand	Demand met by		Population Served by		Coverage	Exist.Omafimas Dungus, Wells
	km2	1993	people/km2	* Pipe W/S	Point W/S	m3/day	* Pipe W/S	Point W/S	* Piped W/S	Point W/S	%	No WP's
Eenhana North Rural	548	2900	5	500	2400	60.5	12.5	48	300	1400	59	60
Eenhana North Semi-Urban	2	2300	1150	2200	100	144	138	6	1300	0	57	
Eenhana South Rural	665	2000	3	0	2000	40	0	40	0	1200	60	50
Eenhana West Rural	442	7100	16	0	7100	142	0	142	0	3600	51	150
Sub-Total Rural	1655	12000	7	500	11500	248.5	12.5	236	300	6200	54	
Sub-Total Semi-Urban	2	2300	1150	2200	100	144	138	6	1300	0	57	
Migration												
Eenhana; Total	**1657**	**14300**	**9**	**2700**	**11600**	**392.5**	**150.5**	**242**	**1600**	**6200**	**55**	**260**
Endola East Rural	149	8100	54	3000	5100	177	75	102	1500	2900	54	120
Endola West Rural	221	11200	51	8000	3200	264	200	64	4000	2900	62	120
Sub-Total Rural	370	19300	52	11000	8300	441	275	166	5500	5800	59	
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0	
Migration												
Endola; Total	**370**	**19300**	**52**	**11000**	**8300**	**441**	**275**	**166**	**5500**	**5800**	**59**	**240**
Engela North Rural	211	12700	60	7500	5200	291.5	187.5	104	3000	5000	63	210
Engela North Semi-Urban	3	3700	1233	3500	200	222	210	12	1400	0	38	
Engela West Rural	206	10200	50	0	10200	150	0	204	0	6500	64	270
Sub-Total Rural	417	22900	55	7500	15400	495.5	187.5	308	3000	11500	63	
Sub-Total Semi-Urban	3	3700	1233	3500	200	222	210	12	1400	0	38	
Migration												
Engela; Total	**420**	**26600**	**63**	**11000**	**15600**	**717.5**	**397.5**	**320**	**4400**	**11500**	**60**	**480**
Ohangwena East Rural	87	7100	82	2000	5100	152	50	102	1900	2600	63	110
Ohangwena North Semi-Urban	2	3200	1600	3000	200	192	180	12	2900	0	91	
Ohangwena West Rural	87	7100	82	2000	5100	152	50	102	1900	2900	68	120
Sub-Total Rural	174	14200	82	4000	10200	304	100	204	3800	5500	65	
Sub-Total Semi-Urban	2	3200	1600	3000	200	192	180	12	2900	0	91	
Migration												
Ohangwena; Total	**176**	**17400**	**99**	**7000**	**10400**	**496**	**280**	**216**	**6700**	**5500**	**70**	**230**
Ondobe East Rural	132	1000	8	0	1000	20	0	20	0	700	70	30
Ondobe North Rural	311	8100	26	4000	4100	182	100	82	2400	2500	62	110
Ondobe South Rural	298	9200	31	0	9200	184	0	184	0	4600	50	190
Sub-Total Rural	741	18300	25	4000	14300	386	100	286	2400	7900	56	
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0	
Migration												
Ondobe; Total	**741**	**18300**	**25**	**4000**	**14300**	**386**	**100**	**286**	**2400**	**7900**	**56**	**330**
Ongenga Rural	225	10200	45	2000	8200	214	50	164	1200	5040	61	210
Ongenga Semi-Urban	2	3200	1600	3000	200	192	180	12	1800	0	56	
Sub-Total Rural	225	10200	45	2000	8200	214	50	164	1200	5040	61	
Sub-Total Semi-Urban	2	3200	1600	3000	200	192	180	12	1800	0	56	
Migration												
Ongenga; Total	**227**	**13400**	**59**	**5000**	**8400**	**406**	**230**	**176**	**3000**	**5040**	**60**	**210**
Oshikango North Rural	148	10200	69	4700	5500	227.5	117.5	110	4500	5040	94	210
Oshikango South Rural	141	8100	57	1000	7100	167	25	142	1000	4600	69	190
Sub-Total Rural	289	18300	63	5700	12600	394.5	142.5	252	5400	9640	82	
Sub-Total Semi-Urban	0		0	0	0	0	0	0	0	0	0	
Migration												
Oshikango; Total	**289**	**18300**	**63**	**5700**	**12600**	**394.5**	**142.5**	**252**	**5400**	**9640**	**82**	**400**
TOTAL MIGRATION												
TOTAL SEMI-URBAN	9	12400	1378	11700	700	750	708	42	7400	0	60	
TOTAL RURAL	3871	115200	30	34700	80500	2483.5	867.5	1616	21600	51580	64	
TOTAL	3880	127600	33	46400	81200	3233.5	1575.5	1658	29000	51580	63	2150

* People residing < 2km fron the pipeline

ANNEX 2. 1/5

VATER SUPPLY DEVELOPMENT PLAN SENARIO 1, OPTION I

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION				WATER DEMAND 2005					EXP. WATER SUPPLY COVERAGE 2005				DEVELOPMENT PROGRAMME FOR RPWS ◘ 1994 – 2005						DEVELOPMENT PROGRAMME FOR RPWSN ◘◘ 1994 – 2005				
Project Area Constituency Sub – Constituency	Area	Population	Popul. Density	Target Population served by		Demand	Demand met BY Pipe & Point W/S		Population Served By		Coverage	No Ex. WPs	Protected Wells 1994 – 2005	PROJECT COSTS				Comm. Construct	Pipe line	PROJECT COSTS				Comm. Construct
	km2	2005	p/km2	* Pipe W/S	Point W/S	m3/day	m3/day	m3/day	* PipedW/S	Point W/S	%	No WP's	No WP's	Constr. N$	O & M. N$	Overhead N$	Labor N$		Km	Constr. N$	O & M. N$	Overhead N$	Labor N$	
Eenhana North Rural	548	4,000	7	800	3,200	84	20	64	800	3,300	103	35	BH100 25	787,500	12,500	47,500	45,000							
Eenhana North Semi–Urban	2	4,100	2,050	4,100	0	246	246	0	3,900	0	95													
Eenhana South Rural	665	2,900	4	1,100	1,800	84	28	36	1,000	1,900	100	36	BH100 14	429,800	7,000	26,600	25,200		50	3,800,000	1,625,000	295,000	350,000	
Eenhana West Rural	442	10,000	23	3,000	7,000	215	75	140	2,900	7,100	100		BH60 118	1,770,000	59,000	224,200	212,400		38	2,888,000	1,235,000	224,200	266,000	
Sub–Total Rural	1,655	16,900	10	3,900	13,000	363	123	240	3,700	12,300	95													
Sub–Total Semi–Urban	2	4,100	2,050	4,100	0	246	246	0	3,900	0	95													
Eenhana; Total	1,657	21,000	13	8,000	13,000	609	369	240	7,600	12,300	95	71	157	2,987,300	78,500	296,300	282,600		88	6,688,000	2,860,000	519,200	616,000	
Endola East Rural	149	11,500	77	11,500	0	288	288	0	10,900	900	103	120							15	1,140,000	487,500	88,500	105,000	
Endola West Rural	221	15,800	71	11,900	3,900	376	298	78	11,300	4,500	100		W. loss 188	488,800	18,800	357,200	338,400		10	760,000	325,000	59,000	70,000	
Sub–Total Rural	370	27,300	74	19,400	7,900	743	585	158	22,200	5,400	101													
Sub–Total Semi–Urban	0	0	0	0	0	0	0	0	0	0	0													
Endola; Total	370	27,300	74	19,400	7,900	743	585	158	22,200	5,400	101	120	188	488,800	18,800	357,200	338,400		25	1,900,000	812,500	147,500	175,000	
Engela North Rural	211	17,900	85	13,000	4,900	423	325	98	12,400	5,500	100		W.loss 230	598,000	23,000	437,000	414,000							
Engela North Semi–Urban	3	6,600	2,200	6,600	0	396	396	0	6,300	0	95													
Engela West Rural	206	14,300	69	2,500	11,800	150	63	236	2,400	11,900	100		W.loss 495	1,287,000	49,500	940,500	891,000							
Sub–Total Rural	417	32,200	77	14,500	17,700	742	388	354	13,800	17,400	97													
Sub–Total Semi–Urban	3	6,600	2,200	6,600	0	396	396	0	6,300	0	95													
Engela; Total	420	38,800	92	21,100	17,700	1,138	784	354	20,100	17,400	97	0	725	1,885,000	72,500	1,377,500	1,305,000		0	0	0	0	0	
Ohangwena East Rural	87	10,000	115	10,000	0	250	250	0	9,500	800	103	110							10	760,000	325,000	59,000	70,000	
Ohangwena North Semi–Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ohangwena West Rural	87	10,000	115	5,300	4,700	227	133	94	5,000	5,000	100		W.loss 210	546,000	21,000	399,000	378,000							
Sub–Total Rural	174	20,000	115	12,300	7,700	537	383	154	11,700	5,800	88													
Sub–Total Semi–Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ohangwena; Total	176	25,700	146	18,000	7,700	879	725	154	17,100	5,800	89	110	210	546,000	21,000	399,000	378,000		10	760,000	325,000	59,000	70,000	
Ondobe East Rural	132	1,400	11	800	600	32	20	12	800	600	100	30	BH60 6	90,000	3,000	11,400	10,800		7	532,000	227,500	41,300	49,000	
Ondobe North Rural	311	11,500	37	11,500	0	288	288	0	10,900	800	** 100	110							63	4,788,000	2,047,500	371,700	441,000	
Ondobe South Rural	298	12,900	43	12,900	0	323	323	0	12,300	1,400	108	190							54	4,104,000	1,755,000	318,600	378,000	
Sub–Total Rural	741	25,800	35	16,500	9,300	615	630	186	24,000	2,800	100													
Sub–Total Semi–Urban	0	0	0	0	0	0	0	0	0	0	0													
Ondobe; Total	741	25,800	35	16,500	9,300	616	630	186	24,000	2,800	100	330	6	90,000	3,000	11,400	10,800		124	9,424,000	4,030,000	731,600	868,000	
Ongenga Rural	225	14,300	64	5,000	9,300	311	125	186	4,800	9,500	100		W.loss 395	1,027,000	39,500	750,500	711,000							
Ongenga Semi–Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Sub–Total Rural	225	14,300	64	5,000	9,300	311	125	186	4,800	7,700	87													
Sub–Total Semi–Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ongenga; Total	227	20,000	88	10,700	9,300	653	467	186	10,200	7,700	90	0	395	1,027,000	39,500	750,500	711,000		0	0	0	0	0	
Oshikango North Rural	148	14,300	97	14,300	0	358	358	0	13,600	5,000	** 130	210							31	2,356,000	1,007,500	182,900	217,000	
Oshikango South Rural	141	11,500	82	11,500	0	288	288	0	10,900	4,600	** 135	190							16	1,216,000	520,000	94,400	112,000	
Sub–Total Rural	289	25,800	89	21,000	4,800	741	645	96	20,000	9,600	100													
Sub–Total Semi–Urban	0	0	0	0	0	0	0	0	0	0	0													
Oshikango; Total	289	25,800	89	21,000	4,800	741	645	96	20,000	9,600	100	400	0	0	0	0	0		47	3,572,000	1,527,500	277,300	329,000	
TOTAL SEMI–URBAN	9	22,100	2,456	22,100	0	1,326	1,326	0	21,000	0	95													
TOTAL RURAL	3,871	162,300	42	92,600	69,700	4,252	2,578	1,374	100,200	61,000	99													
TOTAL	3,880	184,400	48	114,700	69,700	5,578	4,204	1,374	121,200	61,000	99	1,031	1,681	7,004,100	233,300	3,199,900	3,025,800		294	22,344,000	9,555,000	1,734,600	2,056,000	

* People residing < 2km from the pipeline

** There are 85, 130 and 30 omafimas, dungus and wells in the areas of Sub–Constituency Ondobe North, Oshikango North and Oshikango South respectively.
These water points can be utilized for cattle, when the second phase of the new rural pipeline from Omafu to Eenhana is operating.

◘ Rural Point Water Supply

◘◘ *Rural Pipe Water Supply Network*

ANNEX 2 2/5

WATER SUPPLY DEVELOPMENT PLAN, SCENARIO 1, OPTION II

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION				WATER DEMAND 2005					EXP. WATER SUPPLY COVERAGE 2005				DEVELOPMENT PROGRAMME FOR RPWSW ◘ 1994 – 2005						DEVELOPMNET PROGRAMME FOR RPWSN ◘◘ 1994 – 2005				
Project Area / Constituency / Sub – Constituency	Area	Popul.	Popul. Density	Target Population served by		Demand	Demand met by Pipe & Point W/S		Population Served By		Coverage	No Ex. WPs	Protected Wells 1994 – 2005	PROJECT COSTS				Comm. Counselor.	Pipe line	PROJECT COSTS				Comm. Counselor.
	km2	2005	P./km2	*Pipe W/S	Point W/S	m3/day	m3/day	m3/day	* Piped W/S	Point W/S	%	No WPs	No WPs	Comm. N$	O & M N$	Overhead N$	Labour N$		Km	Comm. N$	O & M N$	Overhead N$	Labour N$	
Eenhana North Rural	546	4,000	7	800	3,200	100	20	80	800	3,200	100	25	BH100 25	375,000	12,500	47,500	35,000							
Eenhana North Semi-Urban	2	4,100	2,050	4,100	0	246	246	0	3,900	0	95													
Eenhana South Rural	885	2,900	4	1,100	1,800	73	28	45	1,000	1,900	100	35	BH100 14	429,800	8,400	25,900	21,000		15	1,140,000	487,500	88,500	105,000	
Eenhana West Rural	442	10,000	23	100	9,900	250	3	248	100	9,900	100	40	BH 60 150	2,400,000	80,000	304,000	224,000							
Sub-Total Rural	1,555	16,900	10	2,000	14,900	423	50	373	1,900	15,000	100													
Sub-Total Semi-Urban	2	4,100	2,050	4,100	0	246	246	0	3,900	0	95													
Eenhana; Total	1,657	21,000	13	6,100	14,900	669	296	373	5,800	15,000	99	100	199	3,204,800	100,900	378,100	280,000		15	1,140,000	487,500	88,500	105,000	
Endola East Rural	149	11,500	77	11,500	0	258	258	0	10,900	900	103	120							15	1,140,000	487,500	88,500	105,000	
Endola West Rural	221	15,800	71	11,900	3,900	395	258	98	11,300	4,500	100		W.loss 189	491,400	18,900	359,100	340,200		10	760,000	325,000	59,000	70,000	
Sub-Total Rural	370	27,300	74	23,400	3,900	683	565	98	22,200	5,400	101													
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0													
Endola; Total	370	27,300	74	23,400	3,900	683	565	98	22,200	5,400	101	120	189	491,400	18,900	359,100	340,200		25	1,900,000	812,500	147,500	175,000	
Engela North Rural	211	17,900	85	13,000	4,900	446	325	123	12,400	5,500	100	10	W.loss 225	585,000	22,500	427,500	405,000							
Engela North Semi-Urban	3	6,800	2,200	6,800	0	396	396	0	6,300	0	95													
Engela West Rural	206	14,300	69	2,500	11,800	150	63	295	2,400	11,900	100		W.loss 495	1,287,000	49,500	940,500	891,000							
Sub-Total Rural	417	32,200	77	15,500	16,700	805	388	418	14,700	17,400	100													
Sub-Total Semi-Urban	3	6,800	2,200	6,800	0	396	396	0	6,300	0	95													
Engela; Total	420	38,800	92	22,100	16,700	1,201	784	418	21,000	17,400	99	10	720	1,872,000	72,000	1,368,000	1,296,000		0	0	0	0	0	
Ohangwena East Rural	87	10,000	115	10,000	0	250	250	0	9,500	800	103	110							10	760,000	325,000	59,000	70,000	
Ohangwena North Semi-Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ohangwena West Rural	87	10,000	115	5,300	4,700	250	133	118	5,000	5,000	100		W.loss 210	546,000	21,000	399,000	378,000							
Sub-Total Rural	174	20,000	115	15,300	4,700	500	383	118	14,500	5,800	102													
Sub-Total Semi-Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ohangwena; Total	176	25,700	146	21,000	4,700	842	725	118	19,900	5,800	100	110	210	546,000	21,000	399,000	378,000		10	760,000	325,000	59,000	70,000	
Ondobe East Rural	132	1,400	11	800	600	35	20	15	800	600	100		BH 60 10	150,000	5,000	19,000	14,000		7	532,000	227,500	41,300	49,000	
Ondobe North Rural	311	11,500	37	11,500	0	288	288	0	10,900	600	** 102	110							83	4,788,000	2,047,500	371,700	441,000	
Ondobe South Rural	296	12,900	43	12,900	0	323	323	0	12,300	1,400	105	190		0	0	0	0		45	3,420,000	1,462,500	265,500	315,000	
Sub-Total Rural	741	25,800	35	25,200	600	645	630	15	24,000	2,800	100													
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0													
Ondobe; Total	741	25,800	35	25,200	600	645	630	15	24,000	2,800	100	300	10	150,000	5,000	19,000	14,000		115	8,740,000	3,737,500	678,500	805,000	
Ongenga Rural	225	14,300	64	5,000	9,300	358	125	233	4,800	9,500	100		W.loss 395	1,027,000	39,500	750,500	711,000							
Ongenga Semi-Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Sub-Total Rural	225	14,300	64	5,000	9,300	358	125	233	4,900	9,500	100													
Sub-Total Semi-Urban	2	5,700	2,850	5,700	0	342	342	0	5,400	0	95													
Ongenga; Total	227	20,000	88	10,700	9,300	700	467	233	10,200	9,500	99	0	395	1,027,000	39,500	750,500	711,000		0	0	0	0	0	
Oshikango North Rural	148	14,300	97	14,300	0	358	358	0	13,800	1,500	** 106	210							31	2,356,000	1,007,500	182,900	217,000	
Oshikango South Rural	141	11,500	82	11,500	0	288	288	0	10,900	1,100	** 104	150		0	0	0	0		16	1,216,000	520,000	94,400	112,000	
Sub-Total Rural	289	25,800	89	25,800	0	645	645	0	24,500	2,600	100													
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0													
Oshikango; Total	289	25,800	89	25,800	0	645	645	0	24,500	2,600	100	360	0	0	0	0	0		47	3,572,000	1,527,500	277,300	329,000	
TOTAL SEMI-URBAN	9	22,100	2,456	22,100	0	1,326	1,326	0	21,000	0	95													
TOTAL RURAL	3,871	162,300	42	112,200	50,100	4,058	2,805	1,253	106,600	58,500	102													
	3,880	184,400	48	134,300	50,100	5,384	4,131	1,253	127,600	58,500	101	1,000	1,723	7,291,200	257,300	3,273,700	3,019,200		212	16,112,000	6,890,000	1,250,800	1,484,000	

* People residing < 2km from the pipeline

** There are 55, 130 and 30 omafimas, dungus and wells in the areas of Sub– Constituency Ondobe North, Oshikango North and Oshikango South respectively. These water points can be utilized for cattle, when the second phase of the new rural pipeline from Omafu to Eenhana is operating.

◘ Rural Point Water Supply

◘◘ Rural Pipe Water Supply Network

ANNEX 2 3/5

WATER SUPPLY DEVELOPOMENT PLAN, SCENARIO 2, OPTION 1

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION	WATER DEMAND 2005								EXP. WATER SUPPLY COVERAGE 2005				DEVELOPMENT PROGRAMME FOR RPWS ■ 1994 – 2005						DEVELOPMENT PROGRAMME FOR RPWSN ■■ 1994 – 2005					
Project Area / Constituency	Area	Popul.	Popul. Density	Target Population served by		Demand	Demand met by Pipe & Point W/S		Population Served By Coverage			No Ex. WPs	Protect. Wells 1994 – 2005	PROJECT COSTS			Commun. Contribut.	Pipe line	PROJECT COSTS			Commun. Contribut.
Sub – Constituency	km2	2005	P./km2	*PipeW/S	Point W/S	m3/day	m3/day	m3/day	*PipeW/S	PointW/S	%	NoWPs	No WPs	Constr. N$	O & M	Overhead	Laubor	Km	Constr. N$	O & M	Overhead	Laubor
Eenhana North Rural	548	3,500	6	800	2,700	74	20	54	800	2,700	100	20	BH10■ 21	844,700	10,500	39,900	31,500					
Eenhana North Semi-Urban	2	5,400	2,700	5,400	0	324	324	0	5,100	0	94											
Eenhana South Rural	665	2,500	4	1,100	1,400	56	28	28	1,000	1,500	100	30	BH10■ 11	337,700	5,500	20,900	16,500	50	3,800,000	1,625,000	295,000	350,000
Eenhana West Rural	442	8,300	19	3,000	5,300	181	75	106	2,900	5,400	100	70	BH 66 81	1,215,000	40,500	153,900	113,400	38	2,888,000	1,235,000	224,200	256,000
Sub-Total Rural	1,655	14,300	9	4,900	9,400	311	123	188	4,700	9,600	100											
Sub-Total Semi-Urban	2	5,400	2,700	5,400	0	324	324	0	5,100	0	94											
Migration		1,000		100	900																	
Eenhana; Total	1,657	19,700	12	10,300	9,400	635	447	188	9,800	9,600	98	120	113	2,197,400	56,500	214,700	161,400	88	6,688,000	2,860,000	519,200	616,000
Endola East Rural	149	9,600	64	9,600	0	240	240	0	9,100	900	104	120						15	1,140,000	487,500	88,500	105,000
Endola West Rural	221	13,100	59	11,900	1,200	322	298	24	11,300	1,800	100	35	Wind 65	189,000	6,500	123,500	117,000	10	760,000	325,000	59,000	70,000
Sub-Total Rural	370	22,700	61	21,500	1,200	562	538	24	20,400	2,700	102											
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0											
Migration		1,700		1,000	700																	
Endola; Total	370	22,700	61	21,500	1,200	562	538	24	20,400	2,700	102	155	65	189,000	6,500	123,500	117,000	25	1,900,000	812,500	147,500	175,000
Engela North Rural	211	14,900	71	13,000	1,900	363	325	38	12,400	2,500	100		Wind 105	273,000	10,500	52,500	189,000					
Engela North Semi-Urban	3	8,500	2,833	8,500	0	510	510	0	8,100	0	95											
Engela West Rural	206	11,600	57	2,500	9,300	150	63	186	2,400	9,400	100		Wind 390	1,014,000	39,000	741,000	702,000					
Sub-Total Rural	417	26,700	64	15,500	11,200	512	388	224	14,700	11,900	100											
Sub-Total Semi-Urban	3	8,500	2,833	8,500	0	510	510	0	8,100	0	95											
Migration		2,100		700	1,400																	
Engela; Total	420	35,200	84	24,000	11,200	1,122	695	224	22,800	11,900	99	0	495	1,287,000	49,500	793,500	891,000	0	0	0	0	0
Ohangwena East Rural	87	8,400	97	8,400	0	210	210	0	8,000	800	105	110						10	760,000	325,000	59,000	70,000
Ohangwena North Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95											
Ohangwena West Rural	87	8,400	97	5,300	3,100	195	133	62	5,000	3,400	100		Wind 140	364,000	14,000	266,000	252,000					
Sub-Total Rural	174	16,800	97	13,700	3,100	405	343	62	13,000	4,200	102											
Sub-Total Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95											
Migration		1,200		0	1,200																	
Ohangwena; Total	176	24,100	137	21,000	3,100	843	781	62	19,900	4,200	100	110	140	364,000	14,000	266,000	252,000	10	760,000	325,000	59,000	70,000
Ondobe East Rural	132	1,300	10	800	500	30	20	10	800	500	100	5	BH 4 8	20,800	800	15,200	14,400	7	532,000	227,500	41,300	49,000
Ondobe North Rural	311	9,700	31	9,700	0	243	243	0	9,200	800	** 103	110						63	4,788,000	2,047,500	371,700	441,000
Ondobe South Rural	298	10,500	35	10,500	0	263	263	0	10,000	1,200	107	160						54	4,104,000	1,755,000	318,600	378,000
Sub-Total Rural	741	21,500	29	21,000	500	535	525	10	20,000	2,500	100											
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0											
Migration		1,800		400	1,200																	
Ondobe; Total	741	21,500	29	21,000	500	535	525	10	20,000	2,500	100	275	8	20,800	800	15,200	14,400	124	9,424,000	4,030,000	731,600	868,000
Ongenga Rural	225	12,300	55	5,000	7,300	271	125	146	4,800	7,500	100		Wind 314	816,400	31,400	596,600	565,200					
Ongenga Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95											
Sub-Total Rural	225	12,300	55	5,000	7,300	271	125	146	4,800	7,500	100											
Sub-Total Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95											
Migration		900		200	700																	
Ongenga; Total	227	19,600	86	12,300	7,300	709	563	146	11,700	7,500	98	0	314	816,400	31,400	596,600	565,200	0	0	0	0	0
Oshikango North Rural	148	11,800	80	11,800	0	295	295	0	11,200	1,500	** 108	210						31	2,356,000	1,007,500	182,900	217,000
Oshikango South Rural	141	9,700	69	9,700	0	243	243	0	9,200	1,400	** 109	190						16	1,216,000	520,000	94,400	112,000
Sub-Total Rural	289	21,500	74	21,500	0	538	538	0	20,400	2,900	100											
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0											
Migration		1,600		500	1,100																	
Oshikango; Total	289	21,500	74	21,500	0	538	538	0	20,400	2,900	100	400	0	0	0	0	0	47	3,572,000	1,527,500	277,300	329,000
TOTAL MIGRATION		10,100		2,900	7,200																	
TOTAL SEMI-URBAN	9	28,500	3,167	28,500	0	1,710	1,710	0	27,000	0	95											
TOTAL RURAL	3,871	135,800	35	103,100	32,700	3,232	2,578	654	98,000	41,300	103											
TOTAL	3,880	164,300	42	131,600	32,700	4,942	4,288	654	125,000	41,300	101	1,060	1,135	4,854,900	158,700	2,009,500	2,001,000	294	22,344,000	9,555,000	1,734,800	2,058,000

* People residing < 2km from the pipeline

** There are 85, 130 and 30 omafimas, dungus and wells in the areas of Sub-Constituency Ondobe North, Oshikango North and Oshikango South respectively.

These water points can be utilized for cattle, when the second phase of the new rural pipeline from Omafu to Eenhana is operating.

■ Rural Point Water Supply

■■ Rural Pipe Water Supply Network

ANNEX 2 4/5

WATER SUPPLY DEVELOPMENT PLAN SCENARIO 2, OPTION II

WATER SUPPLY AND SANITATION PROJECT IN OHANGWENA REGION				WATER DEMAND 2005					EXP. WATER SUPPLY COVERAGE 2005				DEVELOPMENT PROGRAMME FOR RPWS ◘ 1994 – 2005					DEVELOPMENT PROGRAMME FOR RPWSN ◘◘ 1994 – 2005				
Project Area / Constituency / Sub – Constituency	Area	Population	Popul. Density	Target Population served by		Demand	Demand met by Pipe &	Point W/S	Population Served By		Coverage	No Ex. WPs	Projected Wells 1994 – 2005		PROJECT COSTS			Comm. Contribut.	Pipe line	PROJECT COSTS			Comm. Contribut.
	km2	2005	people/km2	* Piped W/S	Point W/S	m3/day	m3/day	m3/day	* Piped W/S	Point W/S	%	No WPS		No WPS	Constr. N$	O & M N$	Overhead N$	Labor	Km	Constr. N$	O & M N$	Overhead N$	Labor
Eenhana North Rural	548	3,500	6	800	2,700	74	20	54	800	2,700	100	35	BH100	20	614,000	10,000	38,000	30,000					
Eenhana North Semi-Urban	2	5,400	2,700	5,400	0	324	324	0	5,100	0	94												
Eenhana South Rural	665	2,500	4	1,100	1,400	56	25	26	1,000	1,500	100	40	BH100	10	307,000	5,000	19,000	15,000	15	1,140,000	487,500	86,500	105,000
Eenhana West Rural	442	8,300	19	100	8,200	187	3	184	100	8,200	100	125	BH60	122	1,830,000	61,000	23,180	170,800					
Sub-Total Rural	1,655	14,300	9	2,000	12,300	296	50	245	1,900	12,400	100												
Sub-Total Semi-Urban	2	5,400	2,700	5,400	0	324	324	0	5,100	0	94												
		1,000		100	900																		
Eenhana; Total	1,657	19,700	12	7,400	12,300	620	374	246	7,000	12,400	98	203		152	2,751,000	76,000	80,180	215,800	15	1,140,000	487,500	86,500	105,000
Endola East Rural	149	9,600	64	9,600	0	240	240	0	9,100	900	104	120											
Endola West Rural	221	13,100	59	11,900	1,200	322	298	24	11,300	1,800	100		Wlass	75	195,000	7,500	142,500	112,500	10	760,000	325,000	59,000	70,000
Sub-Total Rural	370	22,700	61	21,500	1,200	562	538	24	20,400	2,700	102												
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0												
Migration		1,700		1,000	700																		
Endola; Total	370	22,700	61	21,500	1,200	562	538	24	20,400	2,700	102	120		75	195,000	7,500	142,500	112,500	25	1,900,000	812,500	147,500	175,000
Engela North Rural	211	14,900	71	13,000	1,900	363	325	38	12,400	2,500	100	145	Wlass	60	156,000	6,000	114,000	90,000					
Engela North Semi-Urban	3	8,500	2,833	8,500	0	510	510	0	8,100	0	95												
Engela West Rural	206	11,500	57	2,500	9,300	150	63	186	2,400	9,400	100		Wlass	390	1,014,000	39,000	741,000	585,000					
Sub-Total Rural	417	26,700	64	15,500	11,200	612	388	224	14,700	11,900	100												
Sub-Total Semi-Urban	3	8,500	2,833	8,500	0	510	510	0	8,100	0	95												
Migration		2,100		700	1,400																		
Engela; Total	420	36,200	84	24,000	11,200	1,122	898	224	22,800	11,900	99	145		450	1,170,000	45,000	855,000	675,000	0	0	0	0	0
Ohangwena East Rural	87	8,400	97	8,400	0	210	210	0	8,000	800	105	110							10	760,000	325,000	59,000	70,000
Ohangwena North Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95												
Ohangwena West Rural	87	8,400	97	5,300	3,100	195	133	62	5,000	3,400	100		Wlass	142	369,200	14,200	269,800	213,000					
Sub-Total Rural	174	16,800	97	13,700	3,100	405	343	62	13,000	4,200	102												
Sub-Total Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95												
Migration		1,200		0	1,200																		
Ohangwena; Total	176	24,100	137	21,000	3,100	843	781	62	19,900	4,200	100	110		142	369,200	14,200	269,800	213,000	10	760,000	325,000	59,000	70,000
Ondobe East Rural	132	1,300	10	800	500	30	20	10	800	500	100	30	BH 60	5	75,000	2,500	950	7,000	7	532,000	227,500	41,300	49,000
Ondobe North Rural	311	9,700	31	9,700	0	243	243	0	9,200	- 600	** 103	110							63	4,788,000	2,047,500	371,700	441,000
Ondobe South Rural	298	10,500	35	10,500	0	263	263	0	10,000	1,400	109	190							45	3,420,000	1,462,500	265,500	315,000
Sub-Total Rural	741	21,500	29	21,000	500	535	525	10	20,000	2,700	100												
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0												
Migration		1,500		400	1,200																		
Ondobe; Total	741	21,500	29	21,000	500	535	525	10	20,000	2,700	100	330		5	75,000	2,500	950	7,000	115	8,740,000	3,737,500	675,500	805,000
Ongenga Rural	225	12,300	55	5,000	7,300	271	125	146	4,800	7,500	100		Wlass	312	811,200	31,200	592,800	468,000					
Ongenga Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95												
Sub-Total Rural	225	12,300	55	5,000	7,300	271	125	146	4,800	7,500	100												
Sub-Total Semi-Urban	2	7,300	3,650	7,300	0	438	438	0	6,900	0	95												
Migration		900		200	700																		
Ongenga; Total	227	19,500	86	12,300	7,300	709	563	146	11,700	7,500	96	0		312	811,200	31,200	592,800	468,000	0	0	0	0	0
Oshikango North Rural	148	11,800	80	11,800	0	295	295	0	11,200	1,500	** 106	205							31	2,356,000	1,007,500	182,900	217,000
Oshikango South Rural	141	9,700	69	9,700	0	243	243	0	9,200	1,300	** 106	150							15	1,216,000	520,000	94,400	112,000
Sub-Total Rural	289	21,500	74	21,500	0	538	538	0	20,400	2,800	100												
Sub-Total Semi-Urban	0	0	0	0	0	0	0	0	0	0	0												
Migration		1,600		500	1,100																		
Oshikango; Total	289	21,500	74	21,500	0	538	538	0	20,400	2,800	100	385		0	0	0	0	0	47	3,572,000	1,527,500	277,300	329,000
TOTAL MIGRATION		10,100		2,900	7,200																		
TOTAL SEMI-URBAN	9	28,500	3,167	28,500	0	1,710	1,710	0	27,000	0	95												
TOTAL RURAL	3,871	135,600	35	100,200	35,600	3,217	2,505	712	95,200	44,200	103												
TOTAL	3,880	164,300	42	129,700	35,600	4,927	4,215	712	122,200	44,200	101	1,293		1,136	5,371,400	178,400	1,941,230	1,691,300	212	18,112,000	8,890,000	1,250,800	1,484,000

* People residing < 2km from the pipeline

** There are 55, 130 and 30 omatmas, dungus and wells in the areas of Sub-Constituency Ondobe North, Oshikango North and Oshikango South respectively. These water points can be utilized for cattle, when the second phase of the new rural pipeline from Omafu to Eenhana is operating.

◘ Rural Point Water Supply

◘◘ Rural Pipe Water Supply Network

ANNEX 2 5/5